

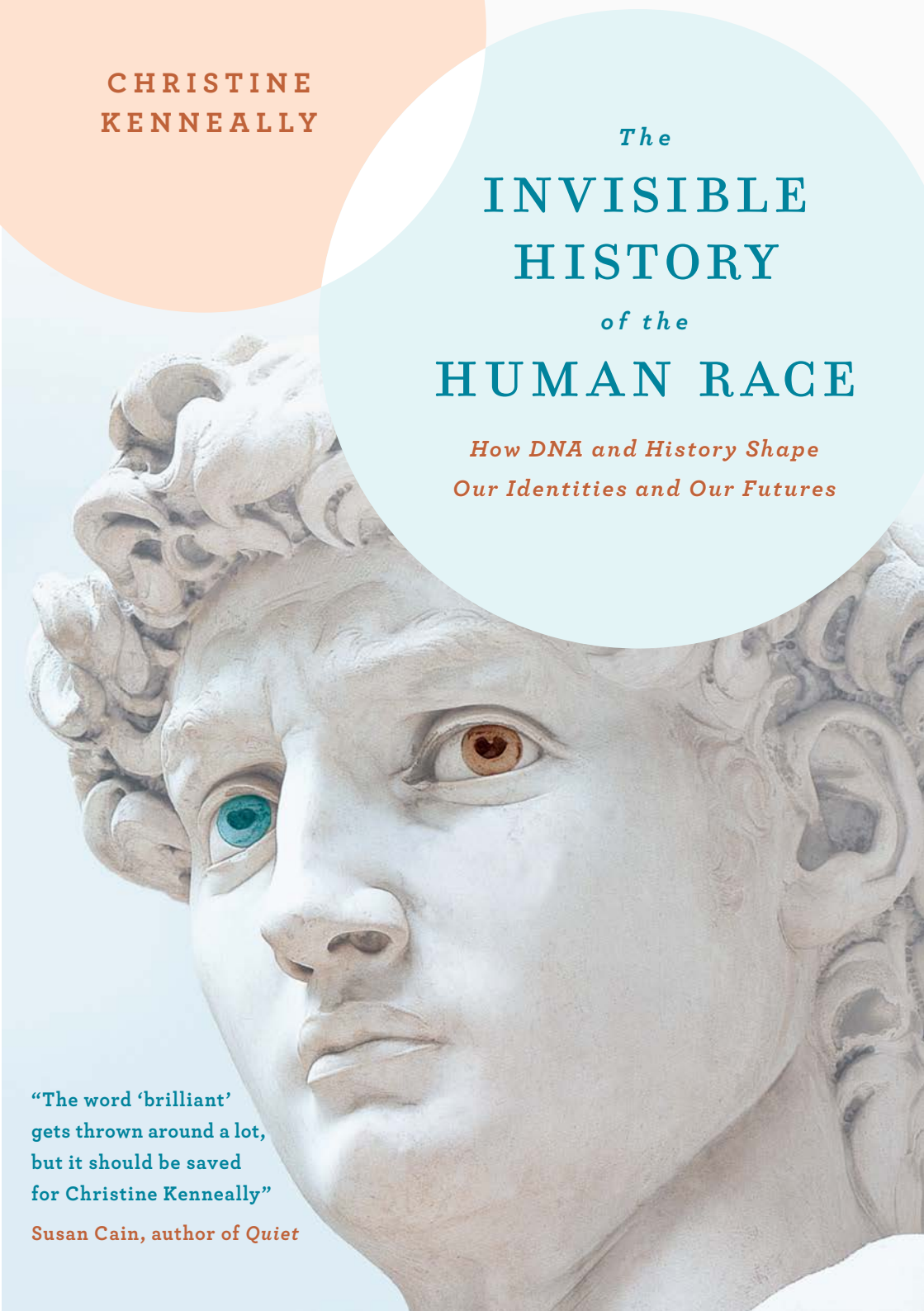
CHRISTINE
KENNEALLY

The
**INVISIBLE
HISTORY**
of the
HUMAN RACE

*How DNA and History Shape
Our Identities and Our Futures*

“The word ‘brilliant’
gets thrown around a lot,
but it should be saved
for Christine Kenneally”

Susan Cain, author of *Quiet*



Introduction

We follow in the steps of our ancestry, and that cannot be broken
—MIDNIGHT OIL

*One cannot and must not try to erase the past merely because it
does not fit the present*
—GOLDA MEIR

There's a moment somewhere between the North Pole and the South when I look out my window and see the top of the Himalayas. At first the shapes are clouds, but then they resolve into immense snow-covered crags, perfectly still in the cumulus sea. It doesn't matter how many times I've seen them before, I am always surprised. They are proof that I am somewhere very high and very strange. At 30,000 feet light floods the plane. Ahead the night drapes across the earth. We barrel towards the darkness, and then we tunnel quickly through it. In a few hours, when we land, it will be morning.

I call my boyfriend's attention to the window. "CB! Look!" He wonders if anyone is over there on the mountains. Perhaps there are a few souls right on the tip. But if so, it's just us and them, and all the other long-distance flying containers up here. We are tracing the outer edge of the human envelope. Below, six billion people inhale. Above, there's nothing to breathe.

It's about this point, when I am too tired to read, I have consumed too much wine, and all I can do is stare, that the human condition starts to get to me. Half the plane is unconscious, the other half

is gingerly stepping over them, and there is a permanent line to the toilets. My boyfriend and I were embarking on a few heady metaphorical trips in addition to this aerial one. We had met in England and were heading to Melbourne to meet my parents. Maybe at some point we would become parents, too. It was momentous to contemplate, and it's a truism that we didn't know the half of it, but we didn't even know what we didn't know.

Here's one thing I didn't know when I was flying above the Indian Ocean. One of my great-great-grandfathers was called Michael Deegan, and 170 years before we got on our plane, he followed a similar trajectory, from high in the northern hemisphere to way down in the south. He was only fifteen years old and he crossed the oceans on a Barque called the *Kinnear*. The trip took 105 days. It left Dublin with 174 men and arrived in Tasmania with 172. Deegan had left a country on the edge of a famine in which one million people died and two and a half million people fled within a ten-year period. He had stolen a handkerchief and was now a convict on his way to Van Diemen's Land. Even if he survived his sentence, he was forbidden to return home. All the *Kinnear's* passengers boarded as criminals, but many of them disembarked compliant. At the end of the journey, the ship's surgeon entered a report on the character of the survivors: "Good," "Orderly," and even "Very Good." Yet somehow Deegan remained "Troublesome."

In the twenty-first century we move through space in these high-speed vessels and through our lives inside little envelopes of time. Usually we know people from the generation or two that come before us, and probably the generation or two that comes after, but mortality draws a thick line across the horizon ahead, and existence—or the lack of it—marks the line behind us. It's not common in the West to have met, or even know much about, anyone born three generations before us. Do these people shape us anyway, whether we know about them or not?

Humanity has been making some consequential moves for a long time now. Over the course of hundreds of thousands of years,

we populated Africa, then we left the continent in waves and spread across the world. The global travel that began 60,000 years ago continued for the next 45,000 years before we settled every habitable continent on earth.

From the ninth century, when Vikings set out to sea in long-boats, through the ages of expansion, slavery, the spice trade and the colonialism that ended in the twentieth century, thousands of ships crossed the oceans. The vessels carried explorers, prisoners, slaves, and immigrants far away from the place where they were born, in most cases never to return. In the second half of the nineteenth century, now known as the age of mass migration, the movement peaked, with more than 55 million emigrants embarking from the old world and heading to the Americas and Australia. On the human scale, the ships marked crucial chapters in the lives of many individuals, and in the lives of everyone who descended from them. Culturally, they changed the stories of families forever. Biologically, the ships delivered mixed samples of human genomes. Everywhere they went, they transformed the human landscape, releasing new variants into the local gene pool, creating never before seen mixes of human material, and founding novel lineages that branched and then branched again.

I wonder if my convict ancestor thought about whether he would have descendants who might one day look back on his life, or who would know him only as a wisp in a cloud of long-dead family? He lived for many, many years after his terrible journey, and though he died long before I was born, I've spoken to people, who have spoken to people, who once spoke to him. Oh look, here comes the human condition again. He and I have physically touched people who have physically touched one another. But although we will never speak, and I will never see him or hear his voice, he is here with me, and not just in my thoughts. This isn't a metaphor, but a fact, as real as the Himalayas. There is information within me that came from him, and if my boyfriend and I have children, some of that information will be inside them, too.

We are ourselves vessels. Inside each cell that is inside each person is a massive library of DNA, 3 billion base pairs that have been passed down to us. I think about this while I sit on the aircraft; the principle is true for all 466 of my fellow passengers, no matter what class they're in or their reasons for travel. They all carry their great-great-ancestors inside, and they carry traces of their ancestor's ancestors, too. Here in this plane are multitudes, 1.4 trillion base pairs that have been passed down through history by millions of people. It's a miracle we ever got off the ground.

In second grade our teacher gave the class a project: We were to go home and interview our parents and then draw a family tree. That afternoon, I explained the project to my parents. I would write my name and birth date, and then I would draw a branch growing up out of my name. At the end of that branch, I would write their names and what they did for a living, and then I would add their parents' names and birth dates, and I would then draw lines stretching up to them.

I had never before thought much about my forebears. My parents had told me that my father's parents had died before I was born, and my mother's parents lived in another country. And yet here, in the tree I was carefully drawing, I could see that these people had once existed, and they were connected to me.

If I was lucky, my teacher said, my parents would be able to name their grandparents—my great-grandparents—and say when they lived and what they did.

But I was not so lucky. It turned out that my parents were interested in the project, but they were upset about it, too: *Why is your teacher asking you these questions? This is homework? What business was it of hers?*

In the end, my parents made a few suggestions, and naturally, I wrote them down. They could have kept a lid on their ire and lied to me right then and there, but that wasn't something they did, and they were too indignant to conceal it. So I learned early that the

past can bother people in surprising ways, and that memory is meaningful but odd. That incident gave rise to a lifelong interest in why family matters, how it shapes you, and especially why people who are long dead still matter so much to you.

Pretty much everyone alive today has been asked some form of the question “Who are you?”, and the ancient and universal impulse has been to respond by talking about our family. For many years I did a good job of squashing that ancient and universal impulse, studying biology and history in high school, and starting a degree and acquiring all sorts of research skills. Occasionally I prodded my mother about my grandparents, but for the most part, a thick mist hung in the part of my brain that stores all the questions about family and history and identity. That changed one day in 1990 when my parents and my four siblings were assembled in my parents’ kitchen, and my father announced that it was time to tell us that the man we thought was his father wasn’t actually his father. The man who raised him, who we thought was our long-dead grandfather, was actually our Dad’s long-dead grandfather. Our father’s mother was our great grandfather’s daughter.

For my father, this was an awful admission. He had trouble speaking, and I can still see his crooked right arm and hand supporting his forehead. My mother had her hand on his shoulder, and we five children sat there watching. Their distress was extraordinary, yet none of us shared it, not then and not since. The world has galloped on since my father was born, and at least in our part of it, few people today are concerned with matters of paternity in way they were in the 1930s. By some mysterious process, even though my conservative parents raised us to be like them, neither did we.

Which is not to say that we weren’t disoriented. A truth that none of us had ever questioned—what is reasonable to call it a small foundation stone of our identity—had cracked. Humans tend not to act well when things like that happen, and I still cringe at my first response, which was to exclaim, “I knew there was something

going on!” only to realize that my father, who never cried, was choking back tears.

What then? My father didn’t want to talk much more about it. But I did: What was his name, this man, my actual paternal grandfather, and shouldn’t his last name be my last name? Who was he, anyway? Did my father look like him? Wait, did I? Like all normal children, I had spent a considerable amount of time imagining the sudden death of both my parents and my ensuing survival adventure. (My knapsack was packed and ready, just in case.) For half-a-minute, the old daydream stirred, for here was a truly unknown unknown, a story that hadn’t been told.

But my father shut it down again. He had once heard a name, he said, but he had no documentary evidence to prove the connection, so he wouldn’t tell us what it was.

And that’s where I got stuck. When you put flesh and blood and information together, you are bound to get some heady mysteries and painful feelings, but what can you ever actually *know*?

Our trip past the Himalayas turned out to be the first of many, and CB and I are now married and back in Melbourne, raising two young American-Australians that we created from scratch.

This morning, a typical morning, begins in the kitchen in a house not too far from the one in which I grew up. But after breakfast we push the dishes to the other end of the table, and the four of us stare at a container full of salt water, a cold bottle of gin, and four glasses with a nip of fluorescent green liquid in each. Although it looks as if we are about to make some cheerful cocktails, it is only foam, and our boys are just 9 and 6. Instead, we are going to extract some cells from our saliva, break them open, and tease the DNA out.

“DNA is—” I begin.

“I know what DNA is,” says my nine-year-old.”

“Okay. What is it?”

“It’s this stuff in your body that goes around.” He drew a tight

spiral in the air with his finger. “It basically introduces you, and where you’re from. And it makes your blood type.”

I was going to crib Wikipedia but this pretty much covers it. I didn’t learn about DNA until the last year of high school, when we dutifully ran through a few Mendelian tables, adding a dominant gene and a recessive gene, or two recessives or two dominants. I enjoyed the neatness of the calculation but I didn’t think much about it beyond that. Back then the word *gene* was barely part of society’s vocabulary, but that changed quickly. Starting in the 1990s, scientists and journalists began to announce with ever-growing frequency that the gene for some trait—intelligence, language, red hair, personality—had finally been found. Much has changed since these early days, but many of the ideas that were popularized then are still around in some form today.

- Genes Are the Atoms of the Biological Universe
- Genes are Father Time, predestination, the hand of fate, the story of your life, inescapably inscribed on your cells
- But only sometimes
- The connection between a single gene and a single trait may be cleanly observable
- The connection between a single gene and a single trait may be murky and complicated
- The connection between many genes and a single trait may be observable and complicated
- A genetic mutation, or a missing gene, or an extra gene or a segment of DNA that doesn’t seem to make anything may still shape you
- Or it may do nothing at all
- Genomes are human barcodes, our ineluctable and most true identity
- You are so shockingly, so powerfully, so undeniably you that you can’t help leaving traces of yourself everywhere you go—a tiny hair, a single cell, a trace of saliva, all may lead back to you

In the late nineties there was even a brief but brightly flaring hope that soon we would all be able to replicate ourselves. Human cloning was a topic in almost every major magazine and newspaper, and at times it felt as if barely a week went by without an article about clones that was written in such urgent tones it seemed our exact replica was about to knock on the front door and demand the car keys. The ethics of cloning was debated endlessly, as were the best candidates for the procedure. In 1998, in a rarely granted interview with the hugely influential software designer and business mogul Bill Gates, Barbara Walters, one of America's most well-known journalists, challenged the billionaire about Microsoft's influence on the world, and Gates' personal influence on his company. And then, in a question that must have felt a lot more piercing and relevant at the time, she probed "Would you want to be cloned?" Wisely, Gates answered that he did not.

As of 2014, there are still no artificially produced human clones, at least none that we know of, and journalists have long since stopped asking people if they want to be cloned. Many well-known animal clones, like Dolly the sheep and the resurrected 'extinct' Ibex, have died (some prematurely, some horribly). Other cloned animals, like Copycat, the world's first cloned pet (born in 2001), are doing well. (The company that created Copycat, however, is no longer in existence). In 2013, for the first time ever, a mouse was cloned from only a single drop of blood. In 2014, a Korean company called Sooam Biotech, announced the birth of a dachshund-clone called Mini-Winnie, which they created for a British woman who won a competition.

If our turn-of-the-century conviction that a race of more us's was imminent has proven to be as goofily off-kilter as our 1950's expectation that by now everyone's car would fly, one of the more interesting consequences of this obsession was learning why the idea doesn't actually work very well. We now know that if you take a person's genome and try to grow another human being from it, the resulting person would of course have much in common with the first, but he

would be different as well. This is because while you can, at least theoretically, replicate a genome, you cannot replicate the precise conditions in which it developed. Genes respond to the environment around them. They get turned on and off by experience, and any one person's life experience is as unique as our mothers once told us it was. Even identical twins raised in the same household can differ in height, facial features or along any number of traits. Typically, the older identical twins get—that is, the more life-experience they have—the more different they look, too.

As far as science is concerned, it's not just our unique lives that make true clones impossible, it's the myriad unpredictable, unrepliable and in some ways unknowable elements of a life that may trigger a genetic response. How could we quantify the factors that may affect a single gene in a year? How could we replicate the exact sequence and number of factors that shape one person's genome in a lifetime? What, for example, was the impact on your genome of that unseasonably hot summer when you were eight? What about that traumatic encounter when you were ten? What was the effect of all that bread you ate at school, which was made from that wheat, which was imported from another country, and which itself had an irreducible, hard-to-recapture life history?

Still, the iconic life of genes—their ubiquitous media presence, the casual way we attribute everything physical or emotional to them or specifically not to them, the intense attention they receive in the booming literature of parenthood, their tell-tale traces at crime scenes, and their Rosetta stone-like status in the science of being human—has grown.

*

Why do we care about where, or rather who, we come from? Is it because of what is passed down to us from previous generations? Do the lives of our forebears impact in some way on ours? Or is that just a story we like to tell ourselves? Within our families, we have many convictions about traits, inheritance and the mysteries of familial

resemblance—she has her father’s nose, he has his grandfather’s cheeky sense of humor, those two are like peas in a pod. But what is real and what is myth; what do we actually know?

Over the years I’ve come to view the silence in my own family about my father’s father as an actual thing, not as the absence of something. I can see that the secret of his birth had a huge impact on his life, and I suspect it has on mine, as well. And what of the man behind the secret? Did he leave anything more significant than the loud bang of a door shut down the generations? Twenty-five percent of my DNA comes from him. How has it shaped me?

This question led me to a few thousand more questions, which in turn eventually led me toward this book. *The Invisible History of the Human Race* became a personal quest to track down people from all over the world who could help me find out about the package of things that get passed down to us from our ancestors. As it turns out, there is a lot in it: Stories and secrets, names and dates, feelings, ideas and decision-making tools, and DNA. And that was merely the beginning. What makes the material that gets passed down in both our minds and our bodies so fundamentally interesting is how it shapes our lives, our identities, and our futures.

It was only after I began my quest that I stumbled across the idea of path dependency, a concept invented by physicists to explain how machines could most efficiently use energy to do their work. Path dependency was taken up to fascinating effect by economists to explain how what happens in the future may depend on the path that was taken from the past to the present. They used it explain why some economies are healthier than others, why some laws are written the way they are, and why technology looks like it does in different places. When we talk about positive or negative spirals in our lives, when something that is good keeps getting better, or when something that is bad feeds back on itself and gets worse, we are talking patterns that are path dependent.

The QWERTY keyboard is the classic example of path dependency in technology. Of all the keyboard set-ups that competed to

become the standard in the era of the typewriter, QWERTY, for some godforsaken reason, won. Despite the fact that it was not the easiest or the best design for human hands, millions of people ended up using it, eventually becoming so firmly established that it was impossible to revise it. People were committed, and that commitment meant that nearly all laptops and keyboard are today laid out in the QWERTY design.¹

When I came across the notion of path dependency I realized like a thunderclap that this book was actually about how path dependency affects people in both their minds and their bodies. Path dependency is, of course, another way of talking about evolution, in that nothing ever evolves completely from out of the blue. The process is fundamentally stepwise: Evolution builds on what came before. The shapes of our bodies and our brains, for example, are constrained by the forms that they took in our ancestors. It's no accident that we look like chimpanzees, because humans and chimpanzees shared an ancestor more than 5 million years ago.

The question that came to concern me, and that lies at the heart of this book, is how many of our decisions, and how much of our self-knowledge, is ultimately path dependent. The only way to find that out, of course, was to pause, turn around, and look back at all the paths the human race has taken. Ideally, that would involve reconstructing some of the significant paths that have led to us to the present—where they began, who travelled along them, where they gently curved and where they turned more sharply. As the saying goes, it's not really the destination that matters, but the journey you take to get there.

Since we are asking what is passed down, we have to ask who is doing the passing? Was it our parents, was it our society, was it our government? Has something been passed down incidentally, or with purpose? Is the transmission complete or partial? And what do we believe about what we are passing down as we pass it down?

1 QWERTY: Jared Diamond popularized the problem of QWERTY, as he has many other issues of path dependant history

Can we even see *what* we are passing down? In the case of culture, we generally believe we can. In the case of DNA, the answer for most of human history has been no.

Still, if you have ever wondered what has been passed down to you, if you have wondered, like me, how much the past really does matter, you are particularly fortunate in being alive at the present moment. Because all the tools that we need to gaze back at the past—the records we have created, the abstract legacies of culture, and the visibility of DNA—have been radically transformed in the last ten years.

The massive digitization of paper records has also completely changed the way we access and use them and, more importantly, what they can tell us. Additionally, and partly because of the utility of these new digital systems, some canny researchers have worked out how to measure the impact of distant historical events on the attitudes of communities today.

And then, of course, there's DNA. Much of our general interest in DNA over the past few decades has been in genes, and how they affect our health and determine our physical features. But as we got to know the genome better, it turned out that DNA has as much to do with our past as it does with our future. We learned that most of the genome is not coding DNA—that is, genes that express proteins, which then carry out some function in our body—but rather non-coding DNA, or what used to be called junk DNA. We now know that even if its impact isn't direct, non-coding DNA may influence our genes in significant ways—or it may do nothing very obvious at all. But even in the latter case, as a group of brilliant scientists has shown, we may learn how to read the book of our history in it.

The most remarkable thing about the use of DNA as a historical tool is that it illuminates not just the biological past but the social past as well. As people make people, who make more people, they pass down not only their genes but an enormous quantity of non-coding DNA, and in all of it we can trace the choices of populations, as well as fateful personal encounters, that took place thousands of

years ago. So, although we have debated for years about the ways in which DNA shapes society (Is it deterministic? Is it indifferent? Does it shape intelligence, behavior, race?), it is also the case that society shapes DNA.

When you bring together DNA with written records and with the more abstract legacies of a community, like its loyalties, emotions, and ideas, what used to be unknowable comes into view in high-definition. The continuous streaming of all history becomes clearer, and we can begin to see not just micro-history and macro-history but also the paths that run between them. What's more, we can begin to untangle the ways in which the operation of genes and our understanding (or misunderstanding) of them also shapes history.

Constructing a history out of all these pieces of information ultimately enables us to understand how the events that occur within our own tiny envelope of existence map onto the stories that extend over long timescales; how lifetimes are shaped by eras and populations; how the lives of ordinary people shape eras; and how much the past makes us who we are, and how free we are from it. Using written records, cultural history and DNA also makes it much easier to understand that the vast forces that shaped the history of the world, shaped you and your family, as well. And the arrow points both ways: Your family has shaped world history.

But here is the problem with finding out what gets passed down: We often feel strongly that we already know what comes down to us, how it comes down, what it looks like, and how it affects us. First, then, we have to examine our fundamental notions about what gets passed down—which, of course, are themselves passed down.



CHRISTINE KENNEALLY is an award-winning journalist and author who has written for *The New Yorker*, *The New York Times*, *Slate*, *Time* magazine, *New Scientist*, *The Monthly*, and other publications. She is the author of *The First Word: The Search for the Origins of Language*, which was a finalist for the *Los Angeles Times* Book Award. She currently lives in Melbourne.

We are doomed to repeat history if we fail to learn from it, but how are we affected by the forces that are invisible to us? In *The Invisible History of the Human Race*, Christine Kenneally draws on cutting-edge research to reveal how both historical artifacts and DNA tell us where we come from and where we may be going. While some books explore our genetic inheritance and popular television shows celebrate ancestry, this is the first book to explore how everything from DNA to emotions to names and the stories that form our lives are all part of our human legacy. Kenneally shows how trust is inherited in Africa, silence is passed down in Tasmania, and how the history of nations is written in our DNA. From fateful, ancient encounters to modern mass migrations and medical diagnoses, Kenneally explains how the forces that shaped the history of the world ultimately shape each human who inhabits it.

Please note, this is an uncorrected sample chapter.

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